court and Esson and of Wilhelmi are readily accessible, and well known, at least to English chemists, the impression on the reader is far from satisfactory. Other instances of like nature could be quoted. J. R. P.

Our Bookshelf.

The British Charophyta. By James Groves and Canon George Russell Bullock-Webster. Vol. i. Nitelleæ. With Introduction. Pp. xiv + 141 + xx plates. (London: The Ray Society, 1920.) Price 25*s.*

This monograph of the British Charophyta is a valuable addition to the literature of British botany. It has also a personal interest for many British botanists as representing the work on this group, embracing much of the leisure of forty years, of the brothers Henry and James Groves, to the former of whom the volume is fittingly dedicated. In 1880 Messrs. H. and J. Groves published in the *Journal of Botany* a "Review of the British Characeæ," in which an attempt was made to give an account of all the then-known British species, with illustrations and some particulars as to their variation and distribution. This was the first of a series of papers by the same authors, in which have been included descriptions and figures of fresh species added from time to time to the British list, records of distribution, and other notes. The present monograph, in which Canon Bullock-Webster co-operates, is the carefully considered outcome of these years of work. The systematic portion, which includes the first of the two subdivisions (Nitelleæ and Chareæ) of the group, is preceded by an introductory section dealing with the growth and structure of the Charophyta generally, and their distribution and affinities; this is well illustrated by numerous text-figures from various sources, and several plates. Each of the species is beautifully represented in a lithographed plate, mainly from drawings by Miss Mary Groves. The authors recognise six genera of Charophyta, five of which, Nitella and Tolypella, comprising the Nitelleæ, and Nitellopsis, Lamprothamnium, and Chara, included in the Chareæ, are represented in Britain. The key to all the British species, which precedes the general systematic account, includes thirty-two species, in several of which distinct varieties are recognised. Under each species there is a complete account of the synonymy with reference to previous publications, a full description in English, and an account of the distribution; notes on variation, affinities, and nomenclature are also added.

Monografia de l'Ordre dels Rafidiòpters (Ins.). By R. P. Llongí Navas, S.J. (Publicacions de l'Institut de Ciències.) Pp. 93. (Barcelona: Institut d'Estudis Catalans, 1918.)

Father Navas is well known as a student of the taxonomy of that miscellaneous assemblage of insects formerly included in the old Linnean order of the Neuroptera. In the monograph before us he deals with the curious and remarkable "snake-flies." Their position in any scheme of classification has long been a difficulty, and opinions thereon are very diverse. Father Navas prefers to follow Handlirsch and to regard them as constituting an order of their own—the Raphidioptera. Others merge them along with the "alder-flies" (Sialidæ) to form the order Megaloptera, while a third alternative is that followed by some entomologists of combining the Megaloptera with the Plannipennia into a single order, Neuroptera. We are inclined to follow the intermediate course, as there is little doubt that the Raphidiidæ have their nearest allies in the Sialidæ, although they are more highly specialised than the latter.

The present monograph is exclusively systematic—only eight lines are devoted to the larval stages, for example—and the sole observations on structure deal entirely with those characters of the external anatomy which are utilised by the systematist. Two families are recognised, comprising thirteen genera and seventy-one species. The greater number of genera occur in Europe and North America; only one genus is African, and four are Asiatic, but none are peculiar to either of those continents. In Britain we have four species comprised within three genera, but the group has been hitherto so little collected that in the next decade we shall probably totally revise our views on its geographical distribution. The author has done a service in bringing together the various species within a single memoir, and his keys and descriptions will enable the different forms to be identified. Of the forty odd figures, many are sketchy and rather deficient in detail.

A. D. I.

Some Famous Problems of the Theory of Numbers and in particular Waring's Problem: An Inaugural Lecture delivered before the University of Oxford. By Prof. G. H. Hardy. Pp. 34. (Oxford: At the Clarendon Press, 1920.) Price 1*s.* 6*d.* net.

The theory of the integral numbers is a subject in which it is frequently easy to conjecture new results and extremely difficult to prove them. An example of a result which must have been based on conjecture is known as Waring's theorem, that every positive integer is the sum of nine (or fewer) positive cubes, of nineteen (or fewer) biquadrates, and so on. A proof of this result, asserted in 1782, was first approached by Prof. Hilbert, of Göttingen, who showed in 1909 that every integer n is the sum of a finite number not exceeding $g(k)$, independent of n, of exact kth powers. It has been established, by transcendental analysis developed long since the days of Waring, that $g(3)=9$ as asserted by him, but whether $g(4)=19$ is still uncertain, though this number has been shown not to exceed 37. The only positive integers known to be inexpressible as a sum of eight cubes (at most) are 23 and 239.

Prof. Hardy and Mr. Littlewood have recently developed a new method of applying properties of

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the Riemann zeta function to the type of problem to which Waring's theorem belongs. In his inaugural address to the University of Oxford on his appointment as Savilian professor of geometry, Prof. Hardy gives a most lucid account of the work on which he has been engaged along with Messrs. Littlewood and Ramanujan. The whole of it is expressed in non-technical language, and many gaps in the theory are explained. We specially note the first few pages as forming a model introduction to a professor's inaugural address. A statement on p. 15 needs amendment, integers expressible as a sum of two squares being of either of the two forms

$$M^2P \text{ or } 2M^2P,$$

where P is a product of positive primes $4k+1$.

W. E. H. B.

On Gravitation and Relativity: being the Halley Lecture delivered on June 12, 1920. By Prof. R. A. Sampson. Pp. 24. (Oxford: At the Clarendon Press, 1920.) Price 2*s*. net.

THERE is a special appropriateness, as Prof. Sampson points out, in choosing a gravitational subject for the Halley Lecture, in view of the important part that Halley played in securing the publication of the "Principia." The lecture is an able *résumé* of the various speculations on the subject, from Galileo's "Dialogues" and Newton's hypothesis of æther-pressure down to Einstein's theory. The author evinces the highest admiration for Einstein's skill in devising a formula which expresses his results "without redundancy, defect, or effort, and whose boldness, range, brilliance, and resounding successes" have commanded universal attention; but on proceeding to examine the formula in detail he confesses to his dislike of some of the devices employed, in particular imaginary time and the obliteration of the distinction between past and future. He alludes to Newton's experiment of the rotating bucket and to Foucault's pendulum experiment as establishing the possibility of detecting the absolute direction of an axis of rotation. It will probably be admitted, even by the convinced relativist, that it is of advantage to students to have the claims of the older "common-sense" kinematics placed before them in an attractive form, which the author has certainly done.

A. C. D. CROMMELIN.

A Primer of Air Navigation. By H. E. Wimperis. Pp. xiv+128. (London: Constable and Co., Ltd., 1920.) Price 8*s*. 6*d*. net.

THIS book provides an interesting and sound introduction to the subject of finding one's way in the air. In many ways the investigation of methods of air navigation is based on nautical experience, but the author points out that the reverse process is beginning to apply. The chief differences appear to arise from the greater speed of aircraft as compared with the steamship, and the considerable altitudes above sea-level reached by the aeroplane and airship. Height in itself gives a wider range of vision, and in clear weather allows a greater permissible error in dead-reckoning without loss of port than is required for a ship seeking harbour. These points are clearly brought out in the little book under notice, and the various steps involved, both of observation and calculation, are developed simply. Whilst non-mathematical in character, we suggest that "Air Navigation" would provide a suitable starting-point for the more complex studies of advanced works and, what is perhaps more important in the present state of aeronautics, encourage capable students to extend the subject into regions yet unexplored. The main ideas of navigation are illustrated by examples from the great flights of the post-war period—Atlantic and Australasian. The correction for wind for aircraft is more important than that for tide and steamship, and clouds interfere with surface observations to an undesirable extent. Such difficulties, at any rate near land, will be countered by the use of direction-finding wireless telegraphy, a subject dealt with in one of the chapters of the book, which may be recommended as covering the essentials of present-day knowledge.

A Junior Inorganic Chemistry. By R. H. Spear. Pp. viii+386. (London: J. and A. Churchill, 1920.) Price 10*s*. 6*d*. net.

ALTHOUGH this does not seem to possess any features differentiating it from many other elementary text-books on chemistry, it is clearly written, and obviously the work of an experienced teacher. In some cases the information is not up-to-date, as on p. 128, where it is stated that "experiments carried out with the most elaborate precautions have shown that 1 grm. of hydrogen combines with 7·98 grm. of oxygen." Ozone is said (p. 177) to have "a faint, peculiar smell." Although molecular formulæ and equations are used freely from p. 152, the molecular theory is not explained until p. 278 is reached. Instructions for experiments are given throughout the book, which provides a good introduction to chemistry.

Part i. of the book, containing the first thirteen chapters, which lead up to, but do not include, the atomic theory, is published separately at the price of 5*s*. net. It provides an introductory course for junior forms in schools.

Atomic and Molecular Theory. By D. L. Hammick. Pp. 82. (Winchester: P. and G. Wells, 1920.)

As an exposition of the simple applications of the atomic theory to chemistry, this account leaves little to be desired in clearness and accuracy. Nothing, however, is said of the recent work which has put the atomic theory on an entirely new basis, and the point of view is that of twenty years ago. One cannot now truthfully say that "Dalton's hypothesis merely restates the facts about the elements and their modes of combination in terms of atoms and, as an 'explanation,' is not very satisfying."

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